Public Health Interventions for Addressing Childhood Overweight: Analysis of the Business Case

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We investigated the appropriateness of basing childhood obesity interventions on expectations of return on investment (ROI). We show that excess weight is indeed associated with greater medical expenditures even among children and adolescents. However, under current best practices, it is unlikely that interventions will be able to meet the level of effectiveness required at a low enough implementation cost to show positive ROI. The merits of childhood obesity interventions should be based on their ability to efficiently control weight and improve health compared with alternative uses for available resources. They should not be based on the potential for short-term financial savings. (Am J Public Health. 2008;98:411–415. doi:10.2105/AJPH.2007.114991)

THE WELL-DOCUMENTED RISE in the prevalence of obesity in the United States is not limited to adults. The prevalence of overweight in children, defined based on 2000 Centers for Disease Control and Prevention growth charts, has also increased dramatically. Between the 1960s and 2002, the prevalence of overweight among children and adolescents aged 6 through 19 years grew from roughly 4% to 16%, a 300% increase.[1,2]

Because obesity increases the risk of a host of adverse medical conditions, there has been considerable attention paid to the economic consequences of the current obesity epidemic. Research has focused on quantifying excess medical expenditures paid by the federal and state governments. Finkelstein et al. showed that total medical expenditures would be roughly 9% lower if there were no obesity among adults and that nearly half of the annual $90 billion obesity price tag is financed by Medicare and Medicaid.[3] A follow-up report that quantified the costs of obesity among full-time employees found that because of increased medical expenditures and absenteeism, a 1000-person firm spends roughly $277 000 more per year because of obesity.[4] These estimates provide an idea of the magnitude of the savings that could be achieved through successful reductions in obesity.

The growing interest in quantifying the economic consequences of childhood overweight is driven by 2 considerations. The first, return on investment (ROI), focuses only on costs and compares the medical and other costs saved by the intervention

with the cost of implementation. The logic is that if the costs of childhood overweight are high enough, the likelihood of funding interventions aimed at reducing them will increase.

The second measure, cost-effectiveness, calculates the net change in costs associated with an intervention relative to the health benefits gained, usually measured as quality-adjusted life-years gained. Interventions that reduce excess weight in children can be cost-effective even if they do not show a positive ROI (i.e., even if there is no net cost saving). In fact, this is the case for most medical and surgical interventions; they improve health but also increase costs. Although there is no common threshold that signifies a cost-effective intervention, medical and surgical interventions that have a cost-effectiveness ratio below $50 000 per quality-adjusted life-year are often considered to be cost-effective.[5]

There are 2 features of the market for obesity prevention and treatment that are relevant for analyzing the ROI of interventions. First, most of the costly complications of obesity do not appear until later in life.[6] Because many of the conditions that obesity contributes to rarely occur in children, it is possible that the costs of childhood overweight are small or nonexistent, at least in the short run. Two previous studies support this conclusion.[7,8]

Second, the time horizon used when calculating ROI is crucial. There is evidence that overweight children are far more likely to become obese adults,[9,10] whose health risks and costs are substantially greater than those of normal-weight adults. Looked at from a lifetime perspective, which is the appropriate time frame for cost–benefit and cost-effectiveness analysis, interventions whose main impact is to reduce costs in the future can still show positive ROI.

We review the business case for interventions aimed at reducing childhood overweight and discuss the appropriateness of basing interventions targeted at children on expectations of ROI. We report new estimates of the cross-sectional costs of childhood overweight. We then use these to answer the following question: how likely is it that a childhood overweight intervention will pay for itself through reductions in health care payments within 5 years? Five years is appropriate because it is rare for researchers to track cost and benefit data beyond this time period (partly because of the 5-year National Institutes of Health funding cycle) and because this is roughly the time period that employers consider when determining investments for employee (and dependent) wellness. We then discuss the implications of relaxing the 5-year target for ROI.

METHODS

Data

We used the same data and statistical models as in our previous studies of adult obesity.[6] Specifically, we pooled data from the 2001 through 2003 Medical Expenditure Panel Survey (MEPS) consolidated data files, a nationally representative survey of the civilian noninstitutionalized population administered by the Agency for Healthcare Research and Quality.[11] We focused on children and adolescents aged 8 through 19 years (N = 20 231).

Statistical Analysis

We used a 2-part regression model to estimate the annual per-child medical costs associated with at-risk and overweight status in children.[6] The first part of the 2-part model used logistic regression to predict the probability of positive expenditures. The dependent variable in the second part of the model was total medical expenditures, and the estimation sample was restricted to those with positive expenditures. We estimated this model by using a generalized linear model with a gamma distribution and a log link as recommended by Manning and Mullahy.[12] We estimated predicted expenditures for each individual by multiplying together both parts of the 2-part model.

The main explanatory variable in the 2-part regression models was body mass index (BMI) category. The 2000 CDC growth charts for the United States were used to categorize children as underweight, normal weight, at risk, or overweight.[13] The categories were based on a child's BMI relative to the national distribution of BMI for children as determined by historical National Health Examination Surveys (NHES) and National Health and Nutrition Examination Surveys (NHANES).[14] BMI categories were as follows: 95th percentile and over, overweight; 85th to 94th percentile, at risk; 5th to 84th percentile, normal weight; below the 5th percentile, underweight. Because the cutoffs were based on historical data, the prevalence of overweight could be more than 5% (Table 1). As a sensitivity check, we also used weight classifications based on the BMI cutoffs suggested by the International Obesity Task Force.[15–18] None of the qualitative results were affected by the change in definitions, nor were any of the estimates

TABLE 1—Prevalence of Weight Ranges Among Children Aged 8 to 19 Years: Medical Expenditure Panel Survey, 2001–2003

Weight Category	Total Sample (N = 20 231), %	Aged 8–13 Years (n = 10 537), %	Aged 14–19 Years (n = 9 694), %
Underweight	6.2	7.7	4.8
Normal	56.1	46.8	65.7
At risk	14.0	14.8	13.1
Overweight	13.9	16.7	11.0
Weight missing	9.8	14.1	5.4

Note. Weight categories are based on a child's body mass index (BMI) relative to the historical national distribution of BMI for children. BMI categories were as follows: 95th percentile and over, overweight; 85th to 94th percentile, at risk; 5th to 84th percentile, normal weight; below the 5th percentile, underweight.

statistically significantly different from those using the CDC growth charts. For this reason, and because our sample is from the United States,[16] we report results using categories based on CDC growth charts.

Both parts of the model also controlled for age, gender, race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and other), insurance (any private insurance during the year, only public insurance during the year, and uninsured the entire year), and census region (Northeast, Midwest, South, and West). The 2-part regression models were estimated for the full sample of children (aged 8–19 years) and separately for younger children (aged 8–13 years) and adolescents (aged 14–19 years).

We calculated costs per child attributable to at-risk and overweight status using the following method. First, we predicted expenditures for each child using observed weight status. Second, we subtracted from that figure predicted expenditures for an otherwise identical child of normal weight. Finally, we averaged the difference in costs over the sample of children initially in the weight category of interest (i.e., at risk or overweight). Cost estimates represented a weighted average of 2001, 2002, and 2003 data. We inflated all costs to 2006 dollars using the Medical Care Consumer Price Index. To maintain the nationally representative nature of the data, we weighted all estimates to account for MEPS sampling design using Stata 9.1 (StataCorp LP, College Station, Tex). Bootstrapped standard errors that accounted for the MEPS sampling design were calculated with 500 bootstrap replications.

TABLE 2—Annual Per-Child Medical Costs Attributable to Excess Weight Among Children Aged 8 to 19 Years: Medical Expenditure Panel Survey, 2001–2003

Weight Category	Total Sample (N = 20 231), $ (95% CI)	Aged 8–13 years (n = 10 537), $ (95% CI)	Aged 14–19 years (n = 9694), $ (95% CI)
At risk	180* (30, 380)	–20 (–150, 140)	430* (130, 740)
Overweight	220* (30, 450)	200 (–80, 500)	270* (10, 520)

Note. CI = confidence interval. Weight categories are based on a child's body mass index (BMI) relative to the historical national distribution of BMI for children. BMI categories were as follows: 95th percentile and over, overweight; 85th to 94th percentile, at risk.
*$P \leq .05$ (z test).

RESULTS

Medical Costs of At-Risk and Overweight Status Among Children

Annual per-child medical expenditures would be $180 less on average (95% bootstrapped confidence interval [CI]=$30, $380) if at-risk children were normal weight; expenditures would be $220 less on average (95% CI=$30, $450) if overweight children were normal weight (Table 2). These estimates were significant at the 95% confidence level. Contrary to our hypothesis, excess weight in children was associated with higher medical expenditures. Our estimates were similar to those reported for children diagnosed with obesity in an academic children's hospital.[19]

Additional analyses revealed that a statistically significant relationship between weight and expenditures existed only for adolescents (aged 14–19 years). Among adolescents, expenditures attributable to at-risk status were $430 (95% CI=$130, $740) and those attributable to overweight were $270 (95% CI=$10, $520). There was no statistically significant difference in attributable expenditures between the at-risk and overweight categories.

These results suggest that the adverse financial consequences of excess weight are evident by the time children reach adolescence. Although many of the direst consequences of obesity are unlikely to appear in adolescence, that trend has been changing, in part because of the increasing prevalence of adolescents who are at the high end of the overweight range. In fact, our data reveal that overweight adolescents are more likely than their normal-weight counterparts to have diabetes (2.0% vs 0.3%), high blood pressure (2.6% vs 0.2%), and asthma (10.1% vs 5.6%).

DISCUSSION

Return on Investment and Childhood Overweight Interventions

Our estimates reveal that the average cost of at-risk and overweight status among children and adolescents is roughly $200 per year, a sum that can buy about 4 visits with a dietician (on the basis of Medicaid reimbursement rates). A childhood overweight intervention that consisted of 4 visits to a dietician each year would have to reverse all costs of excess weight to show a positive ROI. Unfortunately, the evidence suggests that most interventions to prevent overweight in children have shown only limited effectiveness, and not surprisingly, none has documented a positive ROI. For example, a recent review article of controlled trials of interventions among children found that only 4 of the 22 studies included showed statistically significant differences in overweight status or BMI in the treatment groups relative to the control groups.[20]

Only 1 of the 4 studies that found a significant reduction in BMI also reported the costs of the intervention.[21] That intervention substituted dance-oriented sessions for regular school physical activity (e.g., playground activities), in conjunction with a health education program. Converted to 2006 dollars, the intervention required roughly $2000 in initial startup costs and

$1700 each time it was delivered to a class of 43 youths. Assuming that roughly one third of participants were at risk or overweight (the prevalence rate in the MEPS data), there would be approximately $2800 of annual medical costs attributable to at-risk or overweight status in the class before the intervention (14 students × $200 in annual attributable costs). Using a discount rate of 3%, we solved for the amount of attributable costs that the intervention would have had to save per year for the present value of the savings to equal the present value of the intervention costs within 5 years. The intervention would have had to reduce the costs attributable to at-risk and overweight status by 62% to show a positive ROI within 5 years. The intervention actually reduced average BMI by 1 unit relative to the control group for girls, a 4% reduction in average BMI, and had no significant impact on boys, suggesting that the 62% threshold is unlikely to be met by this intervention. The remaining studies that found positive effects appeared to be no less resource intensive, and none was so effective that there is reason to believe it would reduce at-risk and overweight attributable costs by 62%.[22–24]

Motivations for Reductions in Child Overweight

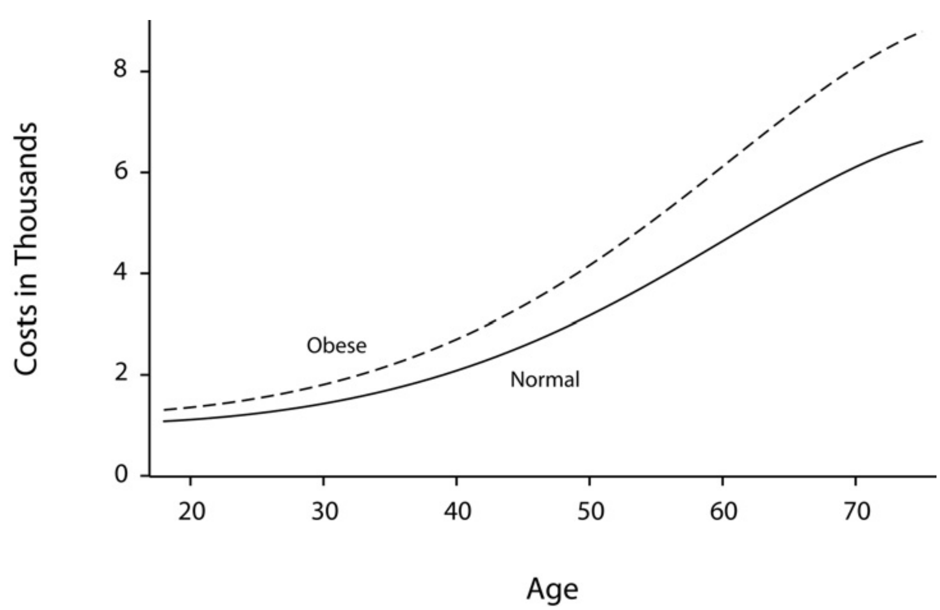
What are the implications of these results? They suggest that even the most effective youth-focused interventions developed to date are unlikely to show a positive ROI in the short time horizon typically considered by researchers and private-sector decisionmakers. This is not to say that effective interventions should not be implemented; rather, public health advocates and researchers should not focus on short-term ROI as a motivation to prevent childhood overweight. Focusing on short-term ROI runs the risk of substantially underselling the benefits of effective interventions. Moreover, the (relatively) low cost of excess weight among youths suggests that many of the adverse health effects of excess weight have not yet manifested themselves. As a result, this may be the most cost-effective age group for interventions.

It is well established that overweight children are more likely to become obese adults,[9,10] and obesity-attributable medical costs grow over the life cycle. Figure 1 shows age-specific annual medical expenditures of obesity (BMI>30 kg/m^2) among adults based on analysis of the 2001 through 2003 MEPS. The figure reveals that, consistent with our findings for children and adolescents, the costs of obesity are small among young adults and grow over time. On the basis of this figure, the present value of the lifetime cost of obesity incurred between the ages of 18 and 75 years approaches $58 000.[25] Thus, childhood overweight interventions that do not show a positive ROI in the short term may save costs in the long term if they positively affect the weight trajectory and cost profile (potentially including medical and other related costs) of individuals into adulthood. Clearly, a longer time horizon is necessary to judge the net benefits of youth-focused interventions.

Moreover, regardless of whether the interventions are cost saving, they still may be at or below established benchmarks for cost-effectiveness (typically $50 000 or less per quality-adjusted life-year for medical interventions), which would justify broader implementation.

Limitations and Conclusions

This analysis is subject to several limitations. In MEPS, the BMI of children was reported by



Source. Finkelstein and Brown.[25]

FIGURE 1—Annual medical expenditures for normal-weight and obese employees: Medical Expenditure Panel Survey, 2001–2003.

an adult caregiver. Although the overall BMI prevalence is consistent with that of other national surveys, the extent of reporting bias at the individual-child level is unknown. Nonmedical costs of childhood overweight, including school absences and associated lost parental work time, and reduced quality of life were not included in the analyses. These factors should be included in a full accounting of the costs and benefits of interventions targeting childhood overweight.

Given a world of limited resources, the merits of childhood overweight interventions should be based on their ability to efficiently control weight and improve the quality and length of life of the target population compared with alternative uses for available resources. They should not be based on the potential for short-term financial savings. ■

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Contributors

Both authors contributed to the conception, design, and analysis and interpretation of data and helped draft the article and revise it critically for important intellectual content.

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